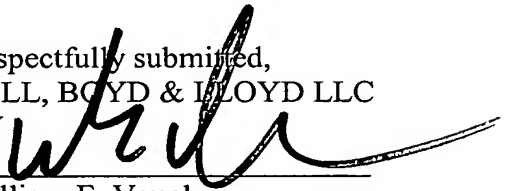


REMARKS

The present amendment makes editorial changes and corrects typographical errors in the specification, which includes the Abstract, in order to conform the specification to the requirements of United States Patent Practice. No new matter is added thereby. Attached hereto is a Substitute Specification including a marked-up version of the changes made thereto via by the present amendment.

In addition, the present amendment cancels original claims 1-24 in favor of new claims 15-36. Claims 15-36 have been presented solely because the revisions by red-lining and underlining which would have been necessary in claims 1-24 in order to present those claims in accordance with preferred United States Patent Practice would have been too extensive, and thus would have been too burdensome. The present amendment is intended for clarification purposes only and not for substantial reasons related to patentability pursuant to 35 U.S.C. §§101, 102, 103 or 112. Indeed, the cancellation of claims 1-24 does not constitute an intent on the part of the Applicants to surrender any of the subject matter of claims 1-24.

Early consideration on the merits is respectfully requested.

Respectfully submitted,
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Dated: January 14, 2005

Marked-Up Version of Substitute Specification

SPECIFICATION

TITLE OF THE INVENTION

Description

~~A method for coding positions of data elements in a data structure~~

A METHOD FOR CODING POSITIONS OF DATA ELEMENTS IN A DATA STRUCTURE

~~The invention relates to a method for coding positions of data elements in a data structure.~~

BACKGROUND OF THE INVENTION

Data structures frequently contain data elements which are to be differentiated by ~~means of~~ their positions with respect to each other. Position coding methods make this possible by allocating position codes to all data elements in a predetermined sequence.

A position coding method is described in [1] which is employed in a method for binary coding of XML data. This method uses XML schema definitions (in the context of a standardized MPEG-7 method, for example) in order to generate the codes for the individual data elements of the XML description. In this respect, individual elements or element groups of the same type as defined by the XML schema definition can occur several times in the document. In this case, a position code (PC) is transmitted. The position code ~~comprises~~ includes the binary representation of a whole number which specifies the position with regard to the adjacent elements. The position code is associated with the element on the basis of the position with respect to the adjacent elements in the document to be coded. This has the advantage that the position code of an element is preserved irrespective of the sequence in which adjacent elements are transmitted. ~~Elements can therefore~~ Elements, therefore, can be lost in transmission without this affecting the position codes or the position of the elements which are subsequently decoded ~~by means of~~ via a decoder.

A disadvantage of this known method is that the XML document must be known at the time of coding since no new positions can be inserted with the previously existing position coding; instead, new positions can just be appended.

This is a disadvantage especially when an XML document is already to be coded or transmitted while it is being ~~created, created;~~ for example example, in live transmissions according to a transmission standard, ~~e.g. such as~~ MPEG-4 or MPEG-7.

For the purposes of solving this problem, gaps can be left between the position codes used, which can be filled when needed. ~~In~~ Particularly in the case of live coding ~~especially,~~ however, the need-based readiness of such gaps which must be defined in advance is difficult to predict. Additionally, the overall quantity of possible gaps is limited by the XML schema definition in many cases. Then, if no more position codes kept free by such gaps are available at the position to be inserted, all the adjacent elements already sent have to be transmitted again with newly generated position codes. This frequently occurs ~~especially in~~ the case of a plurality number of data elements of the same ~~type, e.g. type;~~ type; for example, in the case of identical elements or element groups occurring several times in a document. The consequence is a marked deterioration in coding efficiency and also a markedly increased processing overhead both at the coder and ~~also~~ at the decoder.

The ~~object of the present~~ invention is therefore ~~to create~~ directed toward a method and a device for coding positions of data elements in a data structure in which the positions of newly added data elements can be coded in a simple and efficient manner.

SUMMARY OF THE INVENTION

~~This object is achieved by the method according to Claim 1 or 2 and the device according to Claim 12 or 13. Advantageous versions of the invention are described in the sub-claims.~~

The method according to the present invention has the advantage that the position coding is robust with respect to data loss since position codes are retained. At the same time, where the method is used for coding XML documents, dynamic documents which are generated during the coding process can be coded efficiently. This is made possible by the fact that new positions can be coded between existing positions without elements and their position codes having to be transmitted again.

Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the Figures.

~~In the following, an embodiment of the invention is explained on the basis of the enclosed drawings.~~

BRIEF DESCRIPTION OF THE FIGURES

~~The diagrams show:~~

Fig. 1 ~~A~~is a representation of a position code for a data element, where the position code has been generated with the aid of the method according to the ~~invention;~~present invention.

Fig. 2 ~~A~~shows a data structure where position codes are associated with the data elements, which position codes have been generated with the aid of the method according to the ~~invention;~~present invention.

Fig. 3 ~~The~~shows the data structure ~~shown in of~~ Fig. 2, where two new data elements have been added.

DETAILED DESCRIPTION OF THE INVENTION

In the embodiment of the present invention considered in the following, position codes are associated with the data elements of the data structure in ascending order of the data element positions, which position codes also ~~comprise~~ include rational numbers in a predetermined value range arranged in ascending order. Then, if a position between two existing positions is to be addressed, this is always possible since an infinitesimal quantity of rational numbers always exists between two given rational numbers R_1 and R_2 where $R_1 \neq R_2$. In real implementations, this quantity is admittedly not ~~infinitesimal-infinitesimal~~, but ~~can~~ always may be selected sufficiently ~~large, large; for example-example,~~ >1024. If the position code of the first data element is not equal to zero, data elements whose position code is smaller than the position code of the first data element ~~can~~ also may be inserted.

The use of rational numbers has the further advantage that it enables the shortest possible binary representation.

Fig. 1 shows a position code for a data element. This position code ~~comprises~~ includes the binary representation of a rational number to the base 2 in the value range $]0,1[$ ~~to~~ in $[0,1]$. The binary representation of the rational number ~~comprises~~ includes $N=15$ bits, where $N^*=12$ data bits are present (MSB bit, bit 1 to bit 11; $N^*\leq N$), being arranged in three quadruples. The ~~significances~~ significance of the data bits ~~are~~ is stated under the bits in each case. The data bits are preceded by three extension bits, where the quantity of extension bits specifies the quantity of data bit quadruples present. The first two extension bits are set to one and the last extension bit is set to zero. Setting the last extension bit to zero indicates that the following bits constitute data bits. With the aid of the representation selected in Fig. 1, therefore, a rational number is represented by N bits, of which N^* bits ~~comprise~~ include data bits, where $N^*\leq N$ and $N^*=4k$ (in this respect, k ~~comprises~~ includes a whole number in the value range $[1,\alpha[$ ~~to~~ in $[1,\alpha]$).

Fig. 2 shows a data structure in the form of a data tree, where the position codes of the data elements have been generated with the aid of the inventive method described above. The data structure ~~comprises~~ includes a data element A which is linked to five data elements B. Position codes P are associated with the data elements B in ascending order in the form of rational numbers $1/8$, $1/4$, $3/8$, $1/2$ and $5/8$. Furthermore, the binary representations of the position codes are specified as shown in the diagram in Fig. 1.

Fig. 3 shows a data structure in accordance with Fig. 2, where two more new data elements have been inserted between the data element with the position code $3/8$ and the data element with the position code $1/2$. These newly added data elements are shown in gray in Fig. 3. As a result of the use of rational numbers for the position codes, two values ~~can now~~ may be found for the position codes of the new data elements which lie between the values $3/8$ and $1/2$. The numbers $7/16$ and $15/32$ have been selected for these values in Fig. 3. It is ~~consequently~~ therefore possible to generate new position codes for new data elements in the data structure without the existing position codes having to be changed. Associated position ~~codes can~~ codes, therefore may be retained and any desired number of new data elements inserted at any desired position.

Although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the present invention as set forth in the hereafter appended claims.

References

[1] ISO/IEC 15938-1 Multimedia Content Description Interface – Part 1: Systems, Geneva 2002